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Try $X=0.0045625$ in equation (3) and we have a result approximately within a few mills of a true value.

Therefore the rate of interest per quarter which the investor will realize is $X=0.45625\%$; or $4X=1.825\%$, the investor's rate per annum, payable quarterly.

When there are three rates of interest to be considered in the problem, or the nominal rate expressed in the bond, the investor's rate, and the current or market rate, each per annum, payable quarterly, we let $4Y$=the current rate per annum, payable quarterly, then Y=the current quarterly rate. Put this value in equation (1) and we have:

$$N(1+X)^n=P+I[(1+Y)^n-1]/Y\ldots(4).$$

With equation (4) we have a perfectly general equation from which, by proper substitutions, we may apply it to any loan and find all values required, as N, P, I, n, X, and Y.

The logarithmic calculations in the above solution were made with Shortrede's tables of logarithms and antilogarithms. Should it be necessary to carry the decimals further it would be better to use ten-place tables.

Dr. Zerr's result differs from Mr. DeLand's in that he disregarded the technical consideration required in these bonds. The problem was also solved by A. H. Holmes. ED. F.

280 (Incorrectly numbered 180). Proposed by R. D. CARMICHAEL, Anniston, Ala.

Find values of x, y, z, and u satisfying the equations

$$x+y+z+u=10\ldots[1],$$
$$x^2+y^2+z^2+u^2=30\ldots[2],$$
$$x^3+y^3+z^3+u^3=100\ldots[3],$$
$$x^4+y^4+z^4+u^4=354\ldots[4].$$

Solution by E. A. ECKHARDT, 903 North Fifth Street, Philadelphia, Pa.

By multiplication, addition, and subtraction we obtain

$\Sigma xy=35$
$\Sigma x^2y=300$
$\Sigma xyz=50$
$\Sigma xy^3=646$
$\Sigma x^2y^2=273$
$\Sigma x^2yz=404$
$xyzu=24$

$$\begin{aligned}\Sigma xy^3&=x^3y+x^3z+x^3u+y^3x+y^3z+y^3u+z^3x+z^3y\\&\quad+z^3u+u^3x+u^3y+u^3z.\\&=x^2(xy+xz+xu+yz+yu+zu)\\&\quad-x(xzu+xyu+xyz+yzu)+xyzu\\&\quad+y^3(x+u+z)+z^3(x+y+u)+u^3(x+y+z)\\&=x^2\Sigma xy-4\Sigma xyz+xyzu+y^3(10-y)\\&\quad+z^3(10-z)+u^3(10-u).\end{aligned}$$

$$\Sigma xy^3=x^2\Sigma xy-4\Sigma xyz+xyzu+10(y^3+z^3+u^3)-(y^4+z^4+u^4).$$

Substituting, we have $646=35x^2-50x+24+10(100-x^3)-(354-x^4)$.

Whence, we have $x^4-10x^3+35x^2-50x=-24\ldots(2)$,

or $x^4-10x^3+35x^2-50x+24=0$.

The equations in y, z, and u are found to be identical to (2). The roots of (2) are easily found to be $x=1$, $x=2$, $x=3$, $x=4$. We have, therefore, the following four groups of values:

$$\begin{cases} x=1, & y=2, & z=3, & u=4; \\ x=2, & y=1, & z=4, & u=3; \\ x=3, & y=4, & z=1, & u=2; \\ x=4, & y=3, & z=2, & u=1. \end{cases}$$

Also solved by G. B. M. Zerr, J. Scheffer, and A. H. Holmes.

GEOMETRY.

308. Proposed by **W. J. GREENSTREET, M. A., Editor of The Mathematical Gazette, Stroud, England.**

Find the locus of O, if the differences of the squares of tangents from it to circles A, B, C are x^2, y^2, z^2, respectively.

Solution by **G. B. M. ZERR, A. M., Ph. D., Parsons, W. Va.; A. H. HOLMES, Brunswick, Maine; L. E. NEWCOMB, Los Gatos, California; and J. SCHEFFER, A. M., Hagerstown, Md.**

Let (u, v) be the co-ordinates of the point O;

$(x-m_1)^2+(y-n_1)^2=R_1^2$, the equation of the circle A,

$(x-m_2)^2+(y-n_2)^2=R_2^2$, the equation of the circle B, and

$(x-m_3)^2+(y-n_3)^2=R_3^2$, the equation of the circle C.

Then $(u--m_1)^2+(v-n_1)^2-R_1^2=T_1^2$, the square of the tangent from O to A;

$(u-m_2)^2+(v-n_2)^2-R_2^2=T_2^2$, the square of the tangent from O to B;

$(u-m_3)^2+(x-n_3)^2-R_3^2=T_3^2$, the square of the tangent from O to C.

$\therefore 2(m_2-m_1)u+2(n_2-n_1)v+m_1^2+n_1^2-m_2^2-n_2^2+R_2^2-R_1^2=x^2 \ldots (1)$,

$2(m_3-m_1)u+2(n_3-n_1)v+m_1^2+n_1^2-m_3^2-n_3^2+R_3^2-R_1^2=y^2 .,. (2)$,

$2(m_3-m_2)u+2(n_3-n_2)v+m_2^2+n_2^2-m_3^2-n_3^2+R_3^2-R_2^2=z^2 \ldots (3)$.

Adding (1) and (3) and subtracting (2), we have $x^2+z^2=y^2$ or $y^2-x^2=z^2$, the former being the equation of a circle with a variable radius y, and the latter the equation of an equilateral hyperbola with a variable semi-axes z.

If x, y, and z are constants, the locus is a point.

309. Proposed by **J. SCHEFFER, A. M., Kee Mar College, Hagerstown, Md.**

To find the equation of Brocard's Ellipse, the sides b and c of the triangle being the axes of co-ordinates.

Solution by the **PROPOSER.**

Let AB be the axis of x, AC that of y, then the equation of any ellipse touching the three sides of the triangle is of the form $D^2y^2+4Bxy+E^2x^2+4Dy+4Ex+4=0$, where